

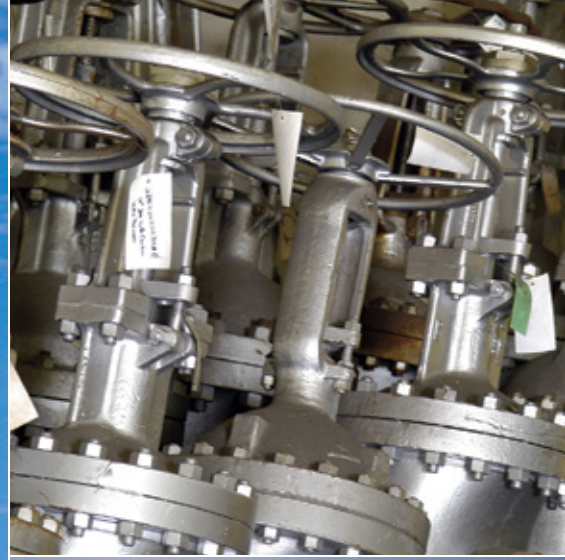


Introduction to API Specification 6A

An overview of API Specification 6A 21st Edition
Released January 2020

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Overview

Cameron supports the development and use of international product standards, such as those published by API and ISO. These standards provide a common basis for product characteristics and performance attributes and act to capture the successful industry history associated with these products. Products marketed, designed, manufactured, and used in compliance with recognized industry standards add significant value to our industry.

Cameron endorses the API Monogram Program and API Quality Program Specifications Q1 and Q2. API Q1 and Q2 apply the recognized benefits of ISO 9001 Quality Program elements tailored specifically to the oil and gas industry. The API Monogram Program joins the assessment of quality programs with the demonstrated ability to comply with international product standards such as API Specification 6A for wellhead and tree equipment.

Cameron routinely provides products and services that meet requirements of international standards such as API and ISO. It is important to also understand that in many cases, standards represent only the industry-accepted minimum requirements. Exceeding minimum requirements is one recognized element of our reputation for high-quality products and services delivered worldwide.

API Specification 6A

API Specification 6A is the recognized industry specification for wellhead and tree equipment that was formulated to provide for the availability of safer, dimensionally and functionally interchangeable wellhead and tree equipment. This specification includes detailed requirements for the manufacture of tubular suspension equipment, valves, and fittings used at the location of oil and gas wells to contain and control pressure and fluid flows.

Specification 6A also serves as the reference source for the design of flanged end and outlet connections for use at 2,000- to 20,000-psi maximum rated working pressures and a family of gate valves for use over these same pressure ranges. API Specification 6A is also specified as the base standard for manufacture of subsea equipment in accordance with API Specifications 17D, 16C, and 16A.

Aftermarket repair and remanufacturing of API 6A equipment is covered under API Standard 6AR. The guidelines for tooling are in API Technical Report 6RT.

Elements not addressed in API 6A include

- advanced design analysis
- research and development
- supplier management
- reliability
- materials characterization
- field maintenance and service
- mandatory product qualification.

Equipment

API Specification 6A covers wellhead and tree equipment as follows:

API Specification 6A

Wellhead Equipment	Valves, Chokes, and Actuators	Plugs, Connectors, and Gaskets	Other Equipment
Casing and tubing heads (housings and adapters)	Single completion valve	Integral, blind, and test flanges	Trees
Casing and tubing hangers (slip and mandrel type)	Multiple completion valves	Ring gaskets	
	Actuated valves	Threaded connectors	
	Valves prepared for actuators	Tees and crosses	
	Check valves	Bullplugs	
	Chokes	Valve-removal plugs	
	Safety valves (SSVs), underwater safety valves (USVs), boarding shutdown valves (BSDVs), and actuators	Top connectors	
	Actuators	Top connectors (nonstandard)	
	Backpressure valves	Crossover connectors	
	Other end connectors (OECs)		
	Spools (adapter and spacer)		

Surface, Underwater Safety, and Boarding Shutdown Valves

Background

Products covered by API 6A include surface safety valves (SSV), underwater safety valves (USV), and boarding shutdown valves (BSDV). An SSV, USV, or BSDV is defined as a power-actuated wellhead valve that will automatically close upon cutoff of the actuator's power supply. API Recommended Practice (RP) 14C covers the use of an SSV, USV, or BSDV—typically as the second master valve in a tree. An SSV is intended for use on offshore platforms, whereas a USV is used subsea. Originally, API 14D covered SSV and USV requirements, but in 1995 API 14D was withdrawn, and an SSV and USV section was added to API 6A. BSDVs were added to API 6A in the 21st edition. While actuated valves and valve actuators for general use are also covered in API 6A, unique additional requirements apply to SSVs, USVs, and BSDVs. For US outer continental shelf installation, SSVs, USVs, and BSDVs must comply with Bureau of

Safety and Environmental Enforcement (BSEE) and 30 CFR part 250 requirements.

PSL, PR, and service class

The minimum product specification level (PSL) for an SSV or USV is PSL-2. The minimum PSL for a BSDV is PSL-3. All SSV, USV, and BSDV designs are required to meet a performance requirement of PR2. A unique performance validation test procedure is required for an SSV, USV, or BSDV design, which is covered in API Spec 6AV1. This can be for one of three service classes:

- Class I (Standard Service): Valve validation per API 6A Annex F PR2F level is required.
- Class II and Class III (Sandy Service): Valve validation per API 6A Annex F PR2 level and API 6AV1 flow test of 500 cycles with sand slurry is required.

The Service Class I, II, or III must be specified when ordering an SSV, USV, or BSDV.

Special design requirements

Requirements for SSV, USV, or BSDV design, apart from those for general-use actuated valves, include

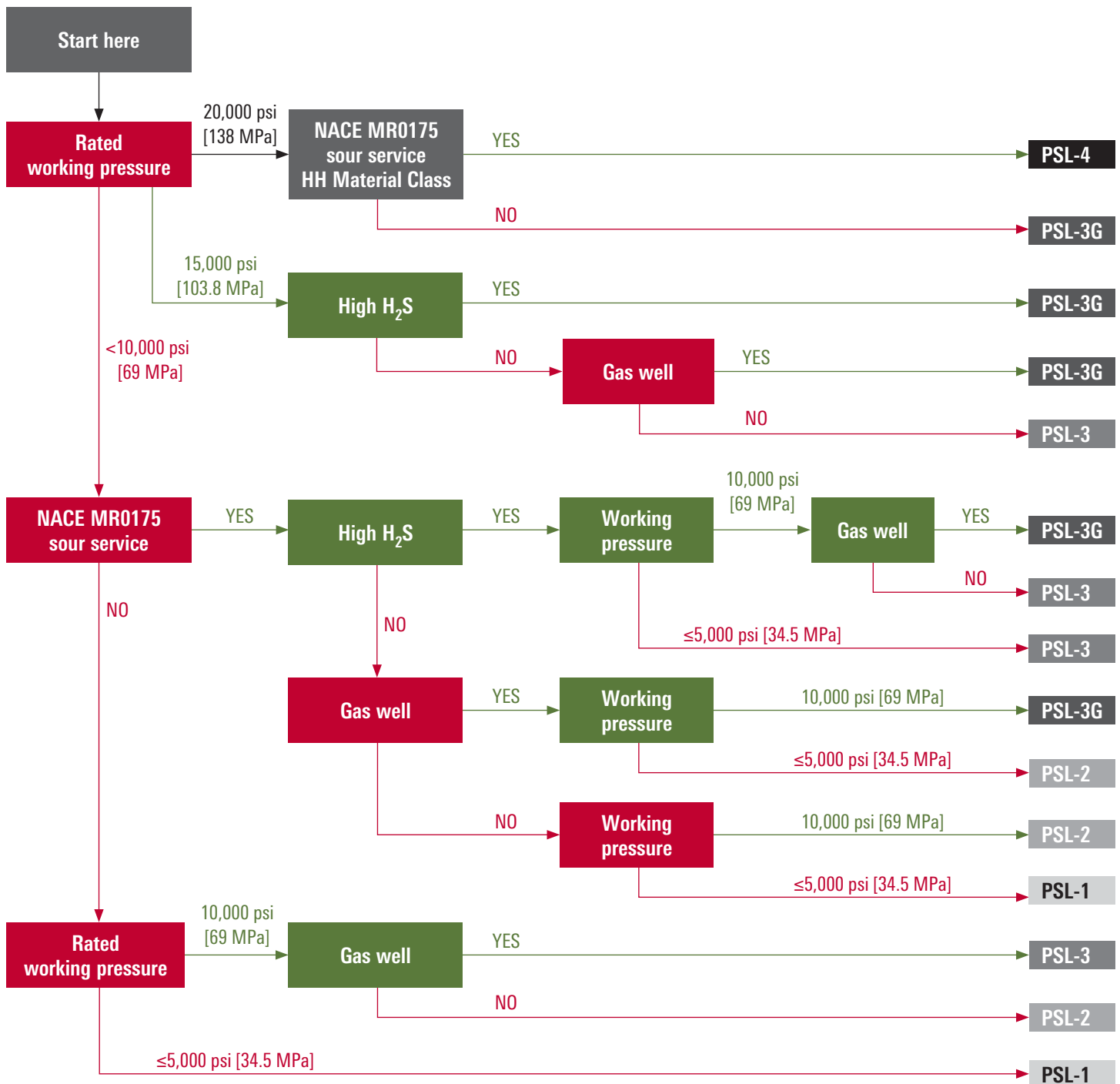
- Threaded-end connections are not permitted.
- Actuators may be hydraulic or pneumatic only.
- The valve must be of normally closed automatic design.
- No lock-open devices are permitted on an SSV actuator except for heat-sensitive designs that automatically enable the valve to close in proximity to a fire.



Product Specification Levels (PSLs)

API Specification 6A defines standard service conditions and introduces the concept of PSLs, which are referred to throughout the document. The PSLs define different levels of documentation, or levels of technical requirements, which may be specified for a product. Generally, these levels represent the industry practice for various service conditions. The selection of a PSL should be based on a quantitative risk analysis, which is a formal

and systematic approach to identifying potentially hazardous events and estimating the likelihood and consequences to people, environment, and resources—and of accidents developing from these events. The decision tree shown below is designed to assist the purchaser in selecting the minimum PSLs for primary parts of wellhead and tree equipment.



Recommended minimum PSL for primary parts.

Product Specification Levels (PSLs)

Applicability of PSLs

Equipment Category and Type (Reference Section)	Applicable PSLs	Equipment Category and Type (Reference Section)	Applicable PSLs
Plugs, connectors, gaskets		Valves and chokes	
Flanges (blind, test) [†] (see 14.1)	1, 2, 3, 4	Valves (gate, plug, ball) (see 14.11)	1, 2, 3, ^{††} 4
Ring gaskets [‡] (see 10.4.5 and 14.2)	NA	Valves (prepared for and actuated) (see 14.11)	1, 2, 3, ^{††} 4
Threaded connectors [†] (see 14.3)	1, 2, 3, 4	Check valves (see 14.11)	1, 2, 3, ^{††} 4
Tees and crosses (see 14.4)	1, 2, 3, ^{††} 4	Backpressure valves [‡] (see 14.12)	NA
Bullplugs [‡] (see 14.5)	NA	SSVs and USVs [§] (see 14.17)	2, 3, ^{††} 4
Valve-removal plugs [‡] (see 14.6)	NA	BSDVs ^{††} (see 14.17)	3, ^{††} 4
Top connectors (see 14.7)	1, 2, 3, ^{††} 4	Chokes (adjustable and positive) (see 14.15)	1, 2, 3, ^{††} 4
Crossover connectors (see 14.8)	1, 2, 3, ^{††} 4	Casing and tubing heads	
Other end connectors [†] (see 14.9)	1, 2, 3, 4	Housings (see 14.14)	1, 2, 3, ^{††} 4
Spools (adapter, spacer) (see 14.10)	1, 2, 3, ^{††} 4	Adapters (see 14.14)	1, 2, 3, ^{††} 4
Weld-neck flanges [†] (see J.1)	1, 2, 3, 4	Other equipment	
Segmented flanges [†] (see L.1)	1, 2, 3, 4	Actuators [†] (see 14.16)	NA
Nonintegral metal seals [†] (see 10.4.5)	1, 2, 3, 4	Tree assemblies [†] (see 14.18)	NA
Casing and tubing hangers		Packing mechanisms [†] (see 9.1)	NA
Slip-type [†] (see 14.13)	1, 2, 3, 4	Pressure boundary penetrations [†] (see 9.2)	NA
Mandrel-type [†] (see 14.13)	1, 2, 3, 4	Test and gauge ports [†] (see 9.3)	NA

[†] Gas testing is not required, so PSL-3G designation is not applicable.

[‡] There is only one level of requirements for these products, so PSLs are not applicable (NA).

[§] PSL-1 is not applicable to SSVs and USVs.

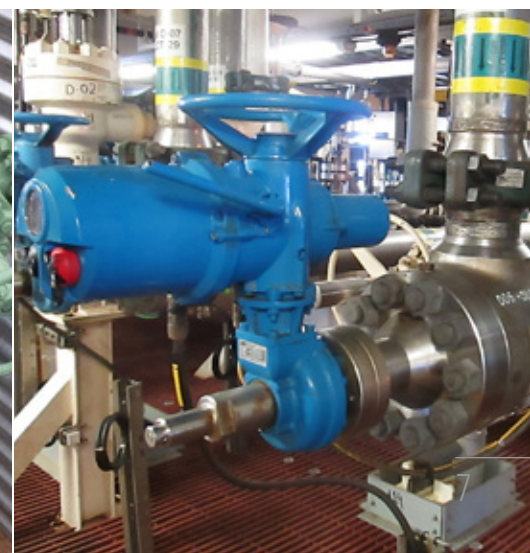
^{††} PSL-1 and PSL-2 are not applicable to BSDVs.

^{†††} For products eligible for gas testing, PSL-3G designation and marking may apply.

Recommended Service Limits for Castings

Rated Working Pressure, psi [MPa]	Material Class		
	AA, BB, CC	DD, EE, FF	HH
2,000 [13.8]	Wrought or cast	Wrought or cast	Wrought or cast
3,000 [20.7]	Wrought or cast	Wrought or cast	Wrought or cast
5,000 [34.5]	Wrought or cast	Wrought or cast	Wrought or cast
10,000 [69.0]	Wrought or cast	Wrought	Wrought
15,000 [103.5]	Wrought	Wrought	Wrought
20,000 [138.0]	Wrought	Wrought	Wrought

See entries on table for minimum PSL on page 11, and diagram on page 6 for additional PSL guidance.



Pressure Ratings

Six pressure ratings from 2,000 to 20,000 psi represent the maximum working pressure of the equipment.

API Pressure Rating, psi [MPa]
2,000 [13.8]
3,000 [20.7]
5,000 [34.5]
10,000 [69.0]
15,000 [103.5]
20,000 [138.0]

Temperature Classes

Eight temperature classes represent a range of temperatures from the minimum ambient air temperature to the maximum temperature of the well fluid passing through or contained by the equipment. Temperature ranges outside these eight classifications are allowed as agreed by the manufacturer and purchaser.

API Temperature Classification	Operating Range, degF [degC]
K	-75 to 180 [-60 to 82]
L	-50 to 180 [-46 to 82]
N	-50 to 140 [-46 to 60]
P	-20 to 180 [-29 to 82]
S	0 to 140 [-18 to 60]
T	0 to 180 [-18 to 82]
U	0 to 250 [-18 to 121]
V	35 to 250 [2 to 121]

Note: These temperature classes can be used in combination with one another to achieve a wider rating. For instance, a common rating for API 6A gate valves is P+U (-20 to 250 degF).

Design Validation Testing

Performance validation testing is often performed on prototypes or production models of API Specification 6A equipment to validate that the performance requirements (PRs) specified for pressure, temperature, load, mechanical cycles, and standard test fluids are met in the design of the product.

Performance validation testing may include

- pressure and temperature cycles
- load and mechanical cycles
- nonmetallic seal thermochemical testing.

Scalable performance validation levels (i.e., PR1, PR2) are applicable to many API 6A products. Although Annex F testing is not a requirement in API 6A, we are proud to offer a wide variety of products proved to meet and often exceed the performance validation requirements of API 6A Annex F. PR2F designates a product validated to PR2 level according to Annex F.

Material classes

Eight material classes specify minimum material requirements for general or sour service shown below. API 6A equipment must be designed, tested, and marked as satisfactory for one of these material classes.

Material Requirements		
API Material Class	Body, Bonnet, End, and Outlet Connections	Mandrel Hangers, Valve Bore Sealing Mechanisms, Choke Trim, and Stems
AA General service	Carbon, low-alloy steel, stainless steel, or corrosion-resistant alloy (CRA) [†]	Carbon, low-alloy steel, stainless steel, or CRA [†]
BB General service	Carbon, low-alloy steel, stainless steel, or CRA [†]	Stainless steel or CRA [†]
CC General service	Stainless steel or CRA [†]	Stainless steel or CRA [†]
DD Sour service [‡]	Carbon, low-alloy steel, stainless steel, or CRA ^{†,§}	Carbon or low-alloy steel or CRA ^{†,§}
EE Sour service [‡]	Carbon or low-alloy steel or CRA ^{†,§}	Stainless steel or CRA ^{†,§}
FF Sour service [‡]	Stainless steel or CRA ^{†,§}	Stainless steel or CRA ^{†,§}
HH Sour service [‡]	CRA ^{†,§,††}	CRA ^{†,§,††}

[†] CRA as defined in 3.1.22; NACE MR0175/ISO 15156 definition of CRA does not apply.

[‡] As defined by NACE MR0175/ISO 15156.

[§] In accordance with NACE MR0175/ISO 15156.

^{††} CRA required on retained fluid-wetted surfaces only; CRA cladding of low-alloy or stainless steel is permitted (see 7.5.1.2).

Age-hardened nickel-based alloys for pressure-containing and pressure-controlling parts that are addressed in API Standard 6ACRA shall conform to API 6ACRA.

NACE MR0175/ISO 15156

API 6A and other product specifications require that metals used for critical parts of equipment in sour service be in compliance with NACE MR0175. Sour service is defined as exposure to oilfield environments that contain sufficient H₂S to cause cracking of materials by the mechanisms addressed by NACE MR0175/ISO 15156. Resistance to cracking caused by H₂S is influenced by several other factors, some of the limits for which are given in NACE MR0175/ISO 15156. These include but are not limited to

- pH
- temperature
- chloride concentration
- elemental sulfur.

Partial pressure formulas

$$\text{H}_2\text{S absolute psi} = \frac{\text{H}_2\text{S ppm}}{1,000,000} \times \text{shut-in pressure}$$

$$\text{H}_2\text{S absolute psi} = \% \text{H}_2\text{S} \times \text{shut-in pressure}$$

$$\text{CO}_2 \text{ absolute psi} = \% \text{CO}_2 \times \text{shut-in pressure}$$

NACE MR0175 lists acceptable materials, including any restrictions on mechanical properties, heat-treat procedures, and method of manufacture. As an example, carbon and low-alloy steels must have a hardness of no more than 22 as measured on the Rockwell C hardness scale (HRC).

MR0175 is revised frequently. Although many additions have been made since it was first published in 1975, most of the requirements for the materials originally included were not changed until the 2003 revision. With this edition, environmental restrictions have been placed on many acceptable materials, which previously had little or no restriction as to

use. As a result, most stainless steels and CRAs are not approved for use across the board, but are approved for use only within certain limits of well-fluid chemistry and temperature.

There are sound reasons for the changes to NACE MR0175. Previous editions did not address the effects of environmental factors other than H₂S on the resistance of materials to sulfide stress cracking. While the major oil and gas companies, drilling companies, and equipment manufacturers were aware of the limitations of the materials they used, the standard did not provide enough guidance for companies with less experience or metallurgical expertise.

Since the 2003 revision, there have been two additional revisions and several technical circulars published that, among other changes, specify new limits or qualification requirements for the alloys described within or the inclusion of a new alloy. The latest version of the standard was released in 2015.

NACE MR0175/ISO 15156 standard enables purchasers to qualify materials for use outside the limits listed within, or to use materials not listed. This can be done by documenting successful service history in a comparable application. Purchasers can also perform material qualification testing, as detailed in MR0175, and avoid the lengthy balloting and approval process. API 6A recognizes materials specified and qualified under this provision of MR0175 as Material Class ZZ.

There are many additional factors that can significantly influence the selection of proper materials in addition to those included in NACE. Factors such as temperature are important considerations during completion and throughout the service life of the well.

Our extensive global experience and understanding of field characteristics combined with our metallurgical expertise can be a valuable asset in your field development planning and execution.

Material Type Individual Alloy UNS Number	Application	Maximum Temperature, degF [degC]	Maximum H ₂ S Partial Pressure, psi [kPa]	Maximum Chloride Concentration, mg/L	In Situ pH	Sulfur Resistant	Remarks
Austenitic stainless steel from materials type described in A.2	Any equipment or component	140 [60]	15 [100]	See "Remarks" column	See "Remarks" column	No	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.
		See "Remarks" column"	See "Remarks" column	50	See "Remarks" column	No	These materials have been used without restrictions on temperature, partial pressure of H ₂ S (pH ₂ S), or in situ pH in production environments. No limits on individual parameters are set but some combinations of the values of these parameters might not be acceptable.
S31600 S31603	Seal rings and gaskets	See "Remarks" column	See "Remarks" column	See "Remarks" column	See "Remarks" column	NDS	Any combination of temperature, pH ₂ S, chloride concentration, and in situ pH occurring in production environments is acceptable.
S31603	Any equipment or component	140 [60]	145 [1,000]	50,000	≥4.5	NDS	
		194 [90]	145 [1,000]	1,000	≥3.5	NDS	
		194 [90]	0.145 [1]	50,000	≥4.5	NDS	
		200 [93]	1.5 [10.2]	5,000	≥5.0	NDS	
		248 [120]	14.5 [100]	1,000	≥3.5	NDS	
	300 [149]	1.5 [10.2]	1,000	≥4.0	NDS		

NDS—No data submitted to ascertain whether these materials are acceptable for service in the presence of elemental sulfur in the environment.

Material Type Individual Alloy UNS Number	Application	Maximum Temperature, degF [degC]	Maximum H ₂ S Partial Pressure, psi [kPa]	Maximum Chloride Concentration, mg/L	In Situ pH	Sulfur Resistant	Remarks
S41000 S41500	Any equipment or components	See "Remarks" column	1.5 [10]	See "Remarks" column	≥3.5	NDS	Subject to limitations on the in situ pH and pH ₂ S, these materials have been used for these components without restriction on temperature and chloride concentration in production environments. No limits on these parameters are set, but some combinations of their values might not be acceptable.
S41000 S41500	Wellhead and tree components, valve and choke components (excluding casing and tubing hangers and valve stems)	See "Remarks" column	See "Remarks" column	See "Remarks" column	≥3.5	NDS	Subject to limitations on in situ pH, these materials have been used for these components without restriction on temperature, pH ₂ S, or Cl ⁻ in production environments. No limits on these parameters are set, but some combinations of their values might not be acceptable.
S17400	Wellhead and production tree components, valves, and chokes (excluding bodies and bonnets)	See "Remarks" column	0.5 [3.4]	See "Remarks" column	≥4.5	NDS	The safe use limits on Cl ⁻ and temperature have not been defined.
Duplex 30 ≤ F _{PREN} ≤ 40.0 Mo ≥ 1.5%	Any equipment or component	450 [232]	1.5 [10]	See "Remarks" column	See "Remarks" column	NDS	These materials have been used without restrictions on in situ pH in production environments. No limits on pH are set, but some values might not be acceptable.
Duplex 40 ≤ F _{PREN} ≤ 45	Any equipment or component	450 [232]	3 [20]	See "Remarks" column	See "Remarks" column	NDS	These materials have been used without restrictions on in situ pH in production environments. No limits on pH are set, but some values might not be acceptable.
Duplex 30 ≤ F _{PREN} ≤ 40.0 Mo ≥ 1.5%	Any equipment or component	See "Remarks" column	See "Remarks" column	50	See "Remarks" column	NDS	These materials have been used without restrictions on temperature, pH ₂ S, or in situ pH in production environments. No limits on individual parameters are set but some combinations of the values of these parameters might not be acceptable.
Duplex 40 ≤ F _{PREN} ≤ 45	Any equipment or component	See "Remarks" column	See "Remarks" column	50	See "Remarks" column	NDS	These materials have been used without restrictions on temperature, pH ₂ S, or in situ pH in production environments. No limits on individual parameters are set but some combinations of the values of these parameters might not be acceptable.
Solid-solution nickel-based alloys; annealed types 4a and 4b	Any equipment or component	See "Remarks" column	See "Remarks" column	See "Remarks" column	See "Remarks" column	Yes	These materials have been used without restriction on temperature, pH ₂ S, chloride concentration, or in situ pH in production environments. No limits on individual parameters are set, but some combinations of the values of these parameters might not be acceptable.
N07718 N09925	Any equipment or component	450 [232]	30 [200]	See "Remarks" column	See "Remarks" column	No	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.
N07718 N09925	Any equipment or component	400 [204]	200 [1,400]	See "Remarks" column	See "Remarks" column	No	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.
N07718 N09925	Any equipment or component	390 [199]	330 [2,300]	See "Remarks" column	See "Remarks" column	No	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.
N07718 N09925	Any equipment or component	375 [191]	360 [2,500]	See "Remarks" column	See "Remarks" column	No	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.

NDS—No data submitted to ascertain whether these materials are acceptable for service in the presence of elemental sulfur in the environment.

F_{PREN}—Number, developed to reflect and predict the pitting resistance of a CRA, based upon the proportions of the elements Cr, Mo, W, and N in the chemical composition of the alloy.

Material Type Individual Alloy UNS Number	Application	Maximum Temperature, degF [degC]	Maximum H ₂ S Partial Pressure, psi [kPa]	Maximum Chloride Concentration, mg/L	In Situ pH	Sulfur Resistant	Remarks
N07718 N09925	Any equipment or component	300 [149]	400 [2,800]	See "Remarks" column	See "Remarks" column	No	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.
N07718 N09925	Any equipment or component	275 [135]	See "Remarks" column	See "Remarks" column	See "Remarks" column	Yes	Any combination of hydrogen sulfide, chloride concentration, and in situ pH in production environments is acceptable.
N07718 API 6ACRA 45HRC max.	Any equipment or component	401 [205]	500 [3,500]	180,000	See "Remarks" column	NDS	Any in situ production environment pH is acceptable for pCO ₂ + pH ₂ S ≤1,000 psi [7,000 kPa].
N09925 (wrought, solution— annealed and aged 38HRC max.)	Any equipment or component	401 [205]	500 [3,500]	180,000	See "Remarks" column	NDS	Any in situ production environment pH is acceptable for pCO ₂ + pH ₂ S ≤1,000 psi [7,000 kPa].
N09945 N09946	Any equipment or component	450 [232]	508 [3,500]	139,000	See "Remarks" column	NDS	Any in situ production environment pH is acceptable for pCO ₂ + pH ₂ S ≤1,000 psi [7,000 kPa].
N09945 N09946	Any equipment or component	401 [205]	508 [3,500]	180,000	See "Remarks" column	NDS	Any in situ production environment pH is acceptable for pCO ₂ + pH ₂ S ≤1,000 psi [7,000 kPa].
N09945	Any equipment or component	350 [177]	1,100 [7,700]	125,000	See "Remarks" column	Yes	Any in situ production environment pH is acceptable for pCO ₂ such that: For pH ₂ S <842 psi [5,800 kPa]: pCO ₂ + pH ₂ S ≤1,450 psi [10,000 kPa]. For pH ₂ S from 5,800 kPa to 7,700 kPa: pCO ₂ ≤610 psi [4,200 kPa].
N07725 (wrought) N07716	Any equipment or component	450 [232]	150 [1,000]	See "Remarks" column	See "Remarks" column	No	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.
N07725 (wrought) N07716	Any equipment or component	425 [218]	300 [2,000]	See "Remarks" column	See "Remarks" column	Yes	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.
N07725 (wrought) N07716	Any equipment or component	400 [204]	600 [4,100]	See "Remarks" column	See "Remarks" column	Yes	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.
N07725 (wrought) N07716	Any equipment or component	350 [177]	See "Remarks" column	See "Remarks" column	See "Remarks" column	Yes	Any combination of chloride concentration and in situ pH occurring in production environments is acceptable.

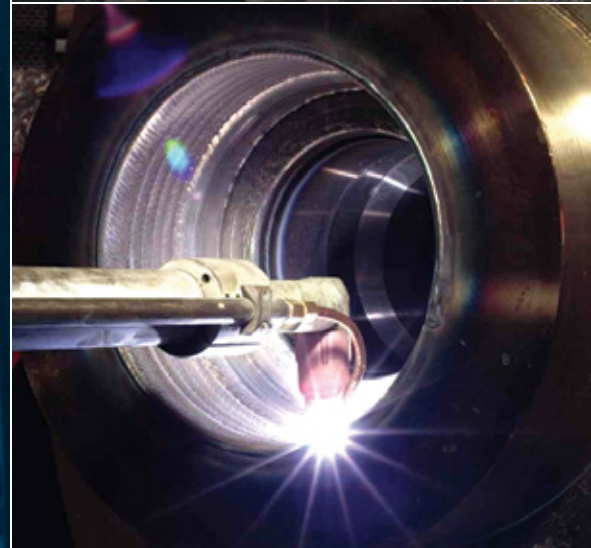
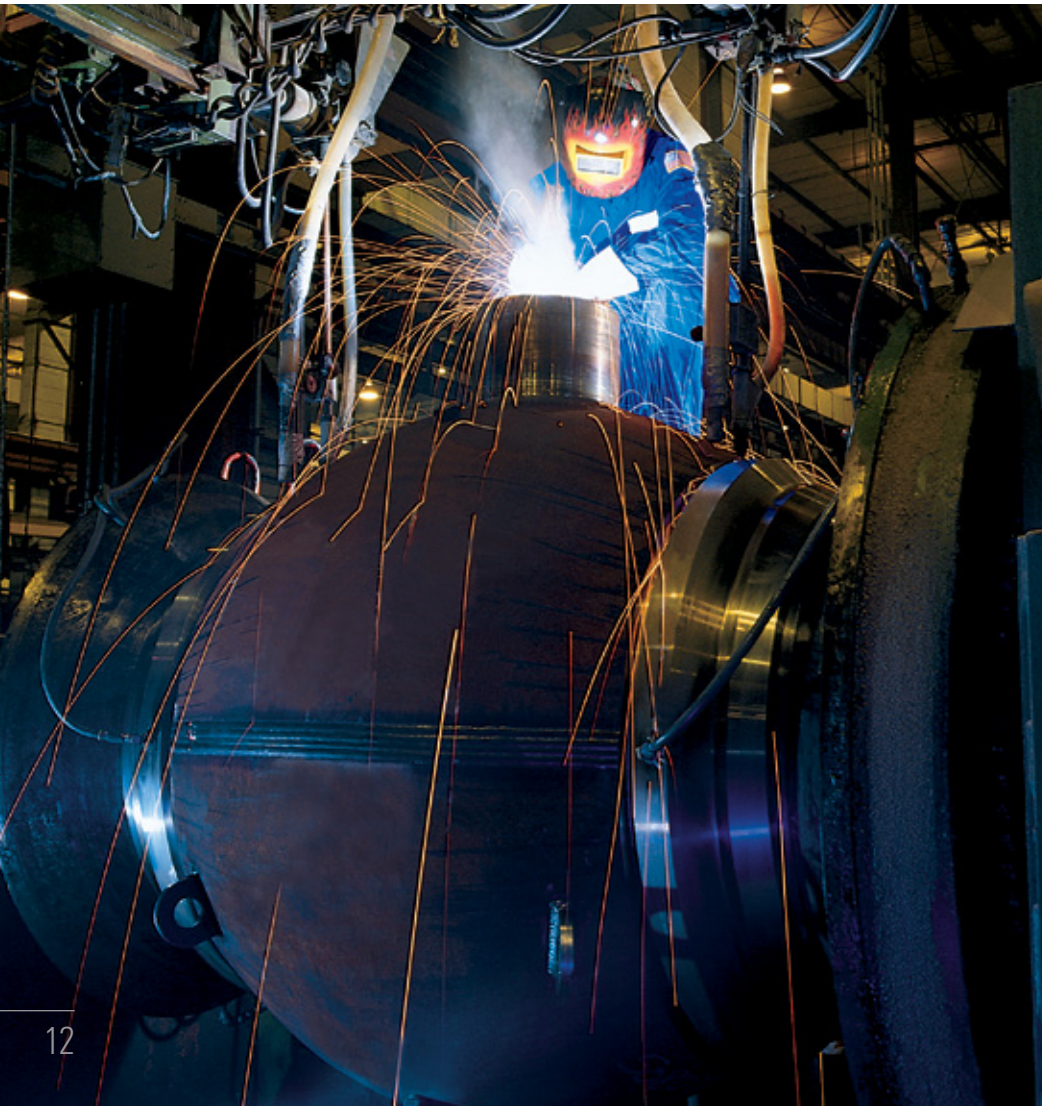
NDS—No data submitted to ascertain whether these materials are acceptable for service in the presence of elemental sulfur in the environment.

F_{PREN}—Number, developed to reflect and predict the pitting resistance of a CRA, based upon the proportions of the elements Cr, Mo, W, and N in the chemical composition of the alloy.

Welding

Quality control requirements for welding generally increase as the PSL increases from 1 through 4 with each level building on the level below it. The following table applies to pressure-containing fabrication and repair weldments for bodies, bonnets, and end and outlet connections.

Welding Requirements for NACE MR0175				
Requirements	PSL-1	PSL-2	PSL-3	PSL-4
Weld procedure qualification	ASME SECT. IX with hardness survey	Same as PSL-1 plus base metal grouping	Same as PSL-2 plus chemical analysis and postweld heat treatment (PWHT) controls	Same as PSL-3 but bolt, tapped, and machined blind holes not allowed
Welder performance qualification	ASME SECT. IX	Same as PSL-1 plus hole qualification	Same as PSL-2	Same as PSL-2
Welding consumables, instrument calibration	Documented controls required	Same as PSL-1	Same as PSL-1	Same as PSL-1
Visual exam of weld	–	Required	Required	Required
Weld surface nondestructive evaluation (NDE): liquid penetrant and magnetic particle testing (PT/MT)	–	Required	Required	Required
Weld volumetric NDE: ultrasonic and radiographic testing (UT/RT)	–	Required for all fabrication welds and repair welds >25% of wall	Required for all fabrication welds and repair welds >20% of wall	Required for all fabrication welds and repair welds >25% of wall
Weld hardness testing	–	–	Required	Required



Quality Control

API Specification 6A describes pertinent information on inspections, tests, examinations, and required documentation. Because the PSL selection is ultimately a purchaser's decision, quality control information is provided to make it easy for users to select the PSL consistent with their risk management needs.

Summary of Factory Acceptance Testing (FAT) Requirements by Equipment Type and PSL

Equipment Type	Hydrostatic Testing, PSL			Gas Testing, PSL			Drift Test, PSL
	Shell Test	Seat Test	Function Test	Body [†] Test	Valve Seat Test	Backseat Test	
Valves (flowline)	1, 2, 3, 4	1, 2, 3, 4	2, 3, 4	3G, 4	3G, 4	3G, [‡] 4	1, 2, 3, 4
Chokes	1, 2, 3, 4	–	–	3G, 4	–	–	–
Tree assemblies	1, 2, 3, 4 [§]	–	–	3G, 4	–	–	1, 2, 3, 4
Casing and tubing heads, housings, and adapters	1, 2, 3, 4	–	–	3G, 4	–	–	–
Adapter and spacer spools, tees and crosses, crossover connectors, and top connectors	1, 2, 3, 4	–	–	3G, 4	–	–	–
Actuators ^{††, ††}	●	●	●	–	–	–	–
Back-pressure valves [†]	–	●	–	–	–	–	–

[†] Body test pressure = rated working pressure

[‡] Optional

[§] See 11.2.3.3 for test pressure requirements

^{††} PSLs are not applicable to this equipment

^{†††} See 14.16.4 for factory acceptance testing requirements

● = Test applies, or PSL does not apply, or both

Quality Control Requirements for Bodies, Bonnets, and End and Outlet Connections

Requirements	PSL-1	PSL-2	PSL-3	PSL-4
Tensile testing	Yes	Yes	Yes	Yes
Impact testing	Temperature Classes K, L, N, and P	Temperature Classes K, L, N, and P	Yes	Yes
Hardness testing	Depends on pressure and material class	Single	Multiple	Multiple
Dimensional verification	Critical dimensions only	Critical dimensions only	Yes	Yes
Traceability	–	Yes	Yes	Yes
Chemical analysis	–	Yes	Yes	Yes
Visual examination	Yes	Yes	–	–
Surface NDE	–	Wetted and sealing surfaces only	100%	Yes
Weld NDE	–	Yes	Yes	Yes
Serialization	–	–	Yes	Yes
Volumetric NDE	–	Castings ≥10,000 psi	Yes	Yes

Note: API 6A enables using cast bodies, bonnets, and end and outlet connections for PSL-1 to PSL-3.

Definitions:

End and outlet connections—Any integral feature of a body used as a means to join together equipment that contains pressure, permits flow of retained fluid between the joined equipment and provides a seal at the joint.

Note 1: End and outlet connectors include, but are not limited to, internal or external thread, clamp hub, studded outlet, and studded or through-bolted.

Note 2: A bonnet connector or a weld preparation is not an end connector.

Body—Any portion of wellhead and tree equipment that includes one or more end connectors and is designed to be exposed to and contain wellbore pressure and fluid.

Bonnet—A pressure-containing closure for a body, other than an end or outlet connection.

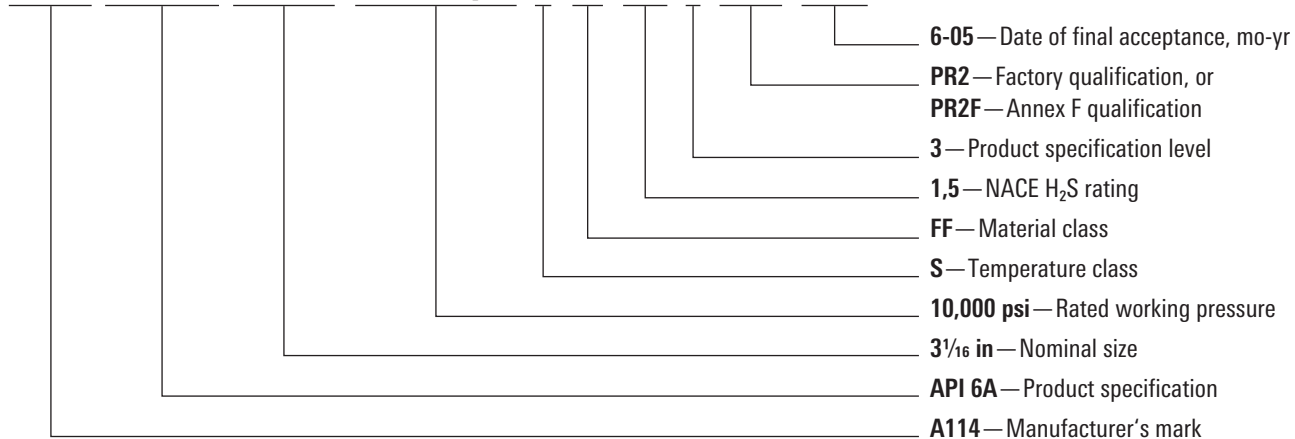
Minimum PSL

Material Class	Rated Working Pressure					
	2,000 psi [13.8 MPa]	3,000 psi [20.7 MPa]	5,000 psi [34.5 MPa]	10,000 psi [69.0 MPa]	15,000 psi [103.5 MPa]	20,000 psi [138.0 MPa]
AA, BB, CC	PSL-1	PSL-1	PSL-1	PSL-2	PSL-2	PSL-3
DD, EE, FF	PSL-1	PSL-1	PSL-1	PSL-2	PSL-3	PSL-3
HH, ZZ	PSL-3	PSL-3	PSL-3	PSL-3	PSL-3	PSL-4

Markings

The marking requirements include the following:

A114-API 6A-3¹/₁₆ in-10,000 psi-S-FF-1,5-3-PR2-6-05



Note: For API monogrammed equipment, the API monogram is also marked along with the license number of the API-approved manufacturing facility.

Note: Equipment rated for sour service is marked with a maximum H₂S rating (in absolute psi), in addition to the material class. Common ratings include the examples shown below.

Material Class	Marking for H ₂ S, 0.5 psi Maximum	Marking for H ₂ S, 1.5 psi Maximum	Marking for H ₂ S, no Limit
AA, BB, CC	Not applicable	Not applicable	Not applicable
DD, EE, FF, HH	0,5	1,5	NL
ZZ	Not required	Not required	Not required

Example: A product marked FF-1,5 indicates material class FF and a 1.5-psi maximum allowable H₂S partial pressure.

API Standard 6AR

Requirement [Corresponding PSL Level]	RL 1 [PSL-1]	RL 2 [PSL-2]	RL 3 [PSL-3]	RL 4 [PSL-4]
Design status indeterminate	●	—	—	—
Design status acceptable	●	●	●	●
Design of product attributes and parts similar to the OPD [†] requirements	●	—	—	—
Design of product attributes and parts meet or exceed OPD requirements	—	●	●	●
Complete disassembly and cleaning	—	●	●	●
Visual examination	●	●	●	●
Dimensional inspection of API 6A specified dimensions	●	●	●	●
Surface NDE for remanufactured parts	—	●	●	●
Welding controlled to include material identification	●	●	●	●
Visual weld examination for remanufactured parts	—	●	●	●
Weld surface NDE for remanufactured parts	—	●	●	●
Weld volumetric NDE for remanufactured parts	—	●	●	●

Requirement [Corresponding PSL Level]	RL 1 [PSL-1]	RL 2 [PSL-2]	RL 3 [PSL-3]	RL 4 [PSL-4]
Weld hardness test	—	—	●	●
Hardness testing for sour service	●	●	●	●
Hardness testing to API 6A specified requirements	—	●	●	●
Reassembly traceability	—	—	●	●
Hydrostatic body test	●	●	●	●
Hydrostatic seat test	●	●	●	●
Extended seat test	—	—	●	●
Drift test	●	●	●	●
Gas test	—	—	●	●
Certificate of conformance provided to customer	—	—	●	●
Assembly traceability and test records provided to customer	—	—	●	●
Complete quality control records provided to customer	—	—	—	●

[†]OPD indicates original product definition as defined by API 6A.

Notable Changes in API 6A 21st Edition		
API 6A 20th Edition	API 6A 21st Edition	Comments
API 6A/ISO 10423	API 6A	ISO 10423 and API 6A are no longer identical
Field use, testing, repair, and tools	Removed	Repairs covered in 6AR and tooling in 6RT
–	Normative references now include API Spec 20A for control of casting materials and API 20E and 20F for bolting	–
“NL” when used with material class is to designate no H ₂ S limits on material, as defined by NACE MR0175	H ₂ S limit are only required to be identified when a specific H ₂ S limit is imposed by NACE MR0175	No restriction on additional NL marking
PSL-1 to PSL-4	PSL selection is restricted based on service condition	Requires higher PSL for monogrammed and some customers
CRA	6ACRA	Applies to all pressure-containing and -controlling CRA parts
Impact test required for temperature rating below –50 degF	PSL-1 with temperature class P (–20 degF) of pressure-containing parts now require impact testing	Requires significant increase in impact testing
Casting control was per manufacturer	API 20A mandatory for castings	Increase in manufacturing control and testing
PSL-3 and 4, QTC max. equivalent round (ER) 5 in	PSL-3 >75,000 psi and 1,000 lbm max. ER is 10 in PSL-4 requires prolongation or production part	Additional testing required; may restrict use of alloy such as 4130
–	Weld repair and documentation for casting shall conform to API 20A CSL3	Additional manufacturing control for casting
–	Weld overlay for HH has minimum thickness of 3 mm or 0.12 in	–
–	API 20E and 20F for closure bolting	Additional processing and testing requirements for closure bolting
Material for lock screw not specified	Material requirements for pressure boundary penetrations shall be compatible with the body material and meet NACE MR0175 for DD, EE, FF, and HH material classes	Lock screw for NACE equipment must be CRA for many flanges
–	Surface NDE requirement added to PSL-1 castings	–
No visible leakage	Clarification added to define allowable pressure change	–
–	Measurements of operating torque required for PSL-3 and PSL-4 valves	–
PSL-4 gas test 1 hour	PSL-4 gas seat test 15 minutes and similar to PSL-3G	–
–	Added conditional seal test	If fitting or pressure boundary penetration not installed during last FAT seal test
Gate valve	Added several new gate valves sizes and special bore for boarding shutdown application	New sizes include 11-in 5,000; 9-in 10,000; 6 $\frac{3}{8}$ -in 15,000; 7 $\frac{1}{8}$ -in 15,000; 4 $\frac{1}{8}$ -in 20,000; 7 $\frac{1}{8}$ -in 20,000; and special bore for BSDV
Safety valve	Included BSDV	Boarding shutdown application was not previously addressed in API 6A product standard
Retained fluid actuator	Retained fluid actuator removed from API 6A	Valve cannot be monogrammed with retained fluid actuator
Informative Annex B	Annex updated	Recommended minimum PSL have increased
PR1 and PR2	PR1, PR2, and PR2F	PR2F requires validation in according with informative Annex F
Normative Annex J	Annex J requirements removed from API 6A	Annex J requirements addressed in API 6AR Standard
Normative Annex H	Annex H requirements removed from API 6A	Annex H requirements addressed in API Technical Report 6RT
Normative Annex I	Annex I requirements removed from API 6A	Annex I requirements in API 6AV1 Standard
Segmented flanges and gaskets	Removed from API 6A main body	Moved to informative Annex L
Informative Annex M	Qualification of heat-treating equipment became requirement and moved to Material and Quality sections	Normative Annex M and about survey of heat-treat equipment



How to Order

General wellhead equipment data sheet

The following data sheet is included as a worksheet for assembling information needed to place an order:

Well name(s) and location(s): _____

Maximum operating pressure: _____

Anticipated wellhead shut-in pressure: _____

Temperature ranges anticipated: _____

Minimum ambient temperature: _____

Maximum flowing fluid temperature at wellhead: _____

Anticipated composition of produced fluids: _____ CO₂ _____ (mg) _____ Chlorides _____ (mg) _____ H₂S _____ (mg) _____ Other

Water or brine pH: _____

Does NACE MR0175/ISO 15156 apply? _____

Anticipated production rates: oil or condensate in _____ m³/d or _____ bbl/d

gas in _____ m³/d or _____ bbl/d

S&W[†] in _____ m³/d or _____ bbl/d

Will erosion be a concern? Cause: _____

Will scale, paraffin, corrosion, or other types of inhibitors be used? _____

Inhibitor type: _____ Inhibitor carrier: _____ Batch or continuous inhibition? _____

Will acidizing be performed? _____ Type of acid: _____

External coating? Yes, Type _____ No _____

Internal coating? Yes, Type _____ No _____

Delivery requirements: _____

Special shipping, packing, and storage instructions: _____

Casing program

	Top Joint String					
	Size, OD	Weight, kg/m [lbm/ft]	Grade	Connection	Max. and min. casing load, N [lbf]	Bit size, mm [in]
Conductor	_____	_____	_____	_____	_____	_____
Surface casing	_____	_____	_____	_____	_____	_____
Protective casing	_____	_____	_____	_____	_____	_____
Production casing	_____	_____	_____	_____	_____	_____
Tubing	_____	_____	_____	_____	_____	_____

Type of completion—single or multiple: _____

Technical contact in buyer's organization: _____ Phone: _____

[†] Sand and water.

For more information, contact your local Cameron representative.

The API Monogram Program

Program description

The American Petroleum Institute administers the API Monogram Program as a service to the global oil and natural gas industry. The program is widely known for the API Monogram symbol, which can be found physically marked on many products used in the industry today. The mark is a warranty by the licensed product manufacturer or service provider to the API and to the purchaser of the product, that a) the item complies in every aspect with the applicable API product specification in effect on the date of manufacture and b) the item was manufactured in conformance with the manufacturer's API-approved quality management system.

API product standards and the API Monogram Program

There are more than 70 API specifications that are currently eligible for licensing under the API Monogram Program. These standards cover a wide variety of products and services used in the industry and are maintained by API's internationally recognized standards organization to keep current with practices and technology used in the industry today.

API quality management system

The API Monogram Program quality management system is based on ISO 9001 with the addition of requirements that are of specific importance to the oil and natural gas industry. The quality management system is documented in API Specification Q1.

The API licensing process

Organizations may voluntarily apply to API for a license to produce and mark products with the official API Monogram. In the application process, the organization must identify the API standard(s) it expects to conform with under the license, which specific products or services within that standard will be included or excluded under the agreement, and the physical location of the facility that will produce the product. Upon acceptance of the organization's application, API will a) review the organization's quality management system documentation for compliance with API Specification Q1, b) perform an onsite audit of the implementation of the organization's quality management system, and c) conduct an on-site evaluation of the organization's capability to produce products in compliance with the applicable API specification(s). If approved, the organization will be issued a numbered license granting it the right to use the API Monogram for a period of three years, during which time the organization may be subject to additional, unannounced audits by the API.

Using the API Monogram

Under the license agreement, the organization may not physically mark any product with the API Monogram that does not fully conform with applicable API standards or if the product manufacture deviated from the licensed organization's quality management system. For each use of the API Monogram, the organization is also required to mark the unique license number issued by the API adjacent to the monogram, which is traceable to the individual API-licensed facility that produced the product.

API Specification Q1 [ISO 29001]

API Specification Q1 [ISO 29001] is intended to be used in conjunction with international oil and gas product standards by internationally licensed manufacturers. Used in this manner, API Specification Q1 delivers significant value to the industry by providing a cohesive link between the accreditation of a manufacturer's quality system and its ability to provide products meeting industry and customer requirements.

API Specification Q1 differs from generic quality systems (e.g., ISO 9001) by its role in the voluntary licensing of manufacturers to provide oil and gas industry products in accordance with API specifications. API licenses are only issued after an onsite survey has confirmed that the licensee adheres to the requirements of both the quality system standard API Specification Q1 and the requirements of an international oil and gas product specification recognized by the oil and gas industry and API.

In contrast, generic quality system requirements are normally intended to be applied to any industry or product through contractual agreements with or without industry standards or specifications.

API Specification Q1 includes the basic quality management system requirements of ISO 9001 and is also published as ISO 29001.

API and ISO Accreditations

Cameron is proud to maintain API and ISO accreditations at many manufacturing and services facilities. In fact, Cameron holds one of the largest number of API licenses in the industry. These accreditations, however, only make up a part of our commitment to quality. We invite you to contact your local Cameron representative and review our commitment to quality in detail.

Country or State	Plant Location	API Licenses	ISO 9001 Certifications
Asia, Australia, and Middle East			
Australia	Deer Park	6A, 16A, 17D, Q1	●
	Perth	6A, Q1	●
Brunei	Kuala Belait, Darussalam	Q2	●
China	Weifang City, Shandong	6D	●
	Songjiang, Shanghai	6A, 16A, Q1	●
	Tianjin	6D, Q1	–
Indonesia	Batam Island	6A, Q1	●
	Bekasi	–	●
Iraq	Basra	–	●
Malaysia	Johor	6A, 16A, 17D	●
	Subang	6A	●
Oman	Muscat	6A, 16A, 16C, Q1	●
Russia	Sakhalin	–	–
Saudi Arabia	Al Rushaid	6A, 16A, 16C, Q1	●
	Jubail (JV)	–	●
Singapore	Singapore	6A, 16A, 17D	●
Thailand	Songkhla	–	–
UAE	Abu Dhabi	–	●
Europe and Africa			
Angola	Luanda	–	●
England	Leeds	–	●
	Newmarket	–	●
	Tunbridge Wells, Kent	–	●
France	Beziers	6A, 16A, 16C, 16F, 16RCD, Q1	●
Germany	Celle	6A, 16A, 16D, 17D, 17F, Q1	●
Ireland	Longford	6A, 16C, 17D Q1	●
Italy	Colico	6A, 6D, 6DSS, 17D, Q1	●
	Milan	–	●
	Voghera	6A, 6D, 6DSS	●
Netherlands	Hoogezand	–	●
Nigeria	Onne Port	6A, Q1	●
	Port Harcourt	6D	●
Norway	Stavanger	6A	●
Romania	Campina	6A, 6D, 16A, 16C, 17D, 7-1	●
	Ploiesti	6A, 6D, 16A, 17D	●
Scotland	Aberdeen	–	●
Trinidad and Tobago	–	–	–

Country or State	Plant Location	API Licenses	ISO 9001 Certifications	
North America				
Canada	Calgary	10th St NE	●	
		Farrell Rd SE	●	
	Edmonton	6A, 6D, 16A, 16C, 608	●	
		3707-97 St	608, 6D	●
		5003-93rd St	6A, 16A, 16C, Q1	●
Newfoundland and Labrador, St. Johns	Q2	–		
Arkansas	Little Rock	6D	●	
California	Bakersfield	6A, Q1	●	
	City of Industry	–	●	
Louisiana	Berwick	6A, 16A, 16C, 16F, 17D, Q1	●	
	New Iberia	6A, Q1	●	
	Ville Platte	6A, 6D, 6DSS	●	
Massachusetts	Millbury	–	●	
Oklahoma	Moore	6A, 16A, Q1	●	
	Oklahoma City	18th St	–	●
		33rd St	6A, 16A, 16C, Q1	–
		7500 SW 29th St	6A, Q1	–
		845 SE 29th St	6D	●
Texas	Houston	11327 Tanner Rd	6A, 16C, 17D, Q1	●
		Brittmoore	16D, 7K, 8C, Q1	●
		Equity Drive	–	●
		JFK Blvd	–	●
		3505 W Sam Houston Pkwy N (Cameron Surface Systems Headquarters)	–	●
	Katy	16A, Q1	●	
	Odessa	2500 Steven Road	–	●
		Rasco Ave	6A, 16A, 16C, 16D, Q1	–
	Waller	6A, 17D, Q1	●	
Wyoming	Casper	12F	–	
South America				
Argentina	Neuquen	–	–	
	Zarate	6A, 16A, Q1	●	
Brazil	Taubate	6A, 17D, Q1	●	
	Macaé	6A, 16A, Q1	●	
Mexico	Veracruz	6A, 16A, 17D, Q1	●	

Introduction to API Specification 6A



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